PATENT
Attorney Docket Number: 07164.0004-02

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Prior Application: Art Unit: 1626

Examiner: S. Wright

SIR: This is a request for filing a

☐ Continuation ☐ Continuation-in-Part ☒ Divisional Application under 37 C.F.R. § 1.53(b) of pending prior application Serial No. 09/496,409 filed February 2, 2000 of Rajnikant Patel for One Pot Synthesis of 2-Oxazolidinone Derivatives.

1. ☒ Enclosed is a complete copy of the prior application including the oath or Declaration and drawings, if any, as originally filed. I hereby verify that the attached papers are a true copy of prior application Serial No. 09/496,409 as originally filed on February 2, 2000.

2. ☐ Enclosed is a substitute specification under 37 C.F.R. § 1.125.

3. ☒ Cancel Claims 1-12 and 14-26.

4. ☐ A Preliminary Amendment is enclosed.

5. ☒ The filing fee is calculated on the basis of the claims existing in the prior application as amended at 3 and 4 above.

Basic Application Filing Fee					$690	$ $690.00
	Number of Claims		Basic	Extra Claims		690.00
Total Claims	1	-	20		x $18	
Independent Claims	1	-	3		X $78	
☐ Presentation of Multiple Dep. Claim(s)					+$260	
Subtotal						$ 690.00
Reduction by 1/2 if small entity						-
TOTAL APPLICATION FILING FEE						$ 690.00

6. ☒ A check in the amount of $690.00 to cover the filing fee is enclosed.

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7. ☒ The Commissioner is hereby authorized to charge any fees which may be required including fees due under 37 C.F.R. § 1.16 and any other fees due under 37 C.F.R. § 1.17, or credit any overpayment during the pendency of this application to Deposit Account No. 06-0916.

8. ☒ Amend the specification by inserting before the first line, the sentence:

--This is a ☐ continuation ☒ division of application Serial No.09/496,409, filed February 2, 2000, which is a divisional of 09/011,045, which is the U.S. National stage application of PCT/GB96/01885 filed August 2, 1996, now U.S. Patent No. 6,084,103.--

9. ☐ New formal drawings are enclosed.

10. ☒ The prior application is assigned of record to Zeneca, Ltd.:

11. ☒ Priority of application Serial No.9516145.1, filed on August 7, 1995 in the United Kingdom is claimed under 35 U.S.C. § 119. A certified copy

☐ is enclosed or ☒ is on file in the prior application.

12. ☐ A verified statement claiming small entity status

☐ is enclosed or ☐ is on file in the prior application.

13. ☒ The power of attorney in the prior application is to at least one of the following: FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P., Douglas B. Henderson, Reg. No. 20,291; Ford F. Farabow, Jr., Reg. No. 20,630; Arthur S. Garrett, Reg. No. 20,338; Donald R. Dunner, Reg. No. 19,073; Brian G. Brunsvold, Reg. No. 22,593; Tipton D. Jennings, IV, Reg. No. 20,645; Jerry D. Voight, Reg. No. 23,020; Laurence R. Hefter, Reg. No. 20,827; Kenneth E. Payne, Reg. No. 23,098; Herbert H. Mintz, Reg. No. 26,691; C. Larry O'Rourke, Reg. No. 26,014; Albert J. Santorelli, Reg. No. 22,610; Michael C. Elmer, Reg. No. 25,857; Richard H. Smith, Reg. No. 20,609; Stephen L. Peterson, Reg. No. 26,325; John M. Romary, Reg. No. 26,331; Bruce C. Zotter, Reg. No. 27,680; Dennis P. O'Reilley, Reg. No. 27,932; Allen M. Sokal, Reg. No. 26,695; Robert D. Bajefsky, Reg. No. 25,387; Richard L. Stroup, Reg. No. 28,478; David W. Hill, Reg. No. 28,220; Thomas L. Irving, Reg. No. 28,619; Charles E. Lipsey, Reg. No. 28,165; Thomas W. Winland, Reg. No. 27,605; Basil J. Lewris, Reg. No. 28,818; Martin I. Fuchs, Reg. No. 28,508; E. Robert Yoches, Reg. No. 30,120; Barry W. Graham, Reg. No. 29,924; Susan Haberman Griffen, Reg. No. 30,907; Richard B. Racine, Reg. No. 30,415; Thomas H. Jenkins, Reg. No. 30,857; Robert E. Converse, Jr., Reg. No. 27,432; Clair X. Mullen, Jr., Reg. No. 20,348;

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14. ☒ The power appears in the original declaration of the prior application.

15. ☐ Since the power does not appear in the original declaration, a copy of the power in the prior application is enclosed.

16. ☒ Please address all correspondence to FINNEGAN, HENDERSON, FARABOW, GARRETT and DUNNER, L.L.P., 1300 I Street, N.W., Washington, D.C. 20005-3315.

17. ☐ Recognize as associate attorney

_____

18. ☐ Also enclosed is _____

_____

PETITION FOR EXTENSION. If any extension of time is necessary for the filing of this application, including any extension in the parent application, Serial no. 09/496,409, filed February 2, 2000, for the purpose of maintaining copendency between the parent application and this application, and such extension has not otherwise been requested, such an extension is hereby requested, and the Commissioner is authorized to charge necessary fees for such an extension to our Deposit Account No. 06-0916. A duplicate copy of this paper is enclosed for use in charging the deposit account.

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FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: September 11, 2000

By: ______________________
Eyal H. Barash
Reg. No. 43,483

09555063 . 090400

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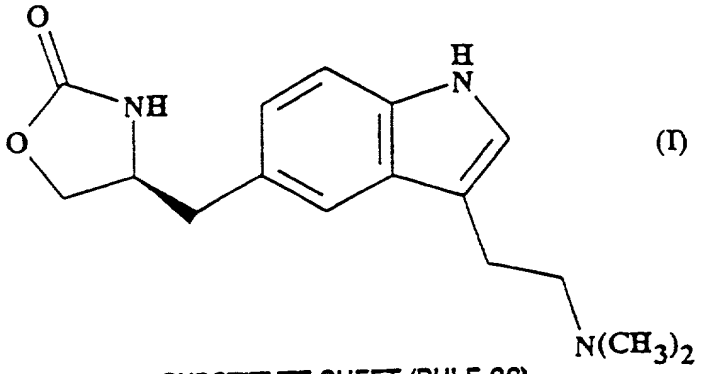
ONE POT SYNTHESIS OF 2-OXAZOLIDINONE DERIVATIVES

The present invention relates to an improved process for preparing substituted indole derivatives which are useful for the treatment and prophylaxis of migraine. More particularly, the present invention provides an improved process for the preparation of the $5HT_1$-like receptor agonist (S)-4-{[3-[2-(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone, which is known to be effective for the treatment of migraine.

Selective 5-HT_1-like receptor agonists are known to be useful therapeutic agents. The 5-HT_1-like receptor mediates vasoconstriction and thus modifies blood flow in the carotid vascular bed. European patent specification 0313397 describes a class of specific 5-HT_1-like receptor agonists which are beneficial in the treatment or prophylaxis of conditions wherein vasoconstriction in the carotid vascular bed is indicated, for example, migraine, a condition associated with excessive dilation of the carotid vasculature.

International patent specification WO91/18897 describes a further class of compounds having exceptional "5-HT_1-like" receptor agonism and excellent absorption following oral dosing. These properties render the compounds disclosed in WO91/18897 particularly useful for certain medical applications, notably the prophylaxis and treatment of migraine, cluster headache and headache associated with vascular disorders, hereinafter referred to collectively as "migraine". One particularly preferred compound described in WO91/18897 is (S)-N,N-dimethyl-2-[5-(2-oxo-1,3-oxazolidin-4-yl-methyl)-1H-indol-3-yl]ethylamine which is also known as (S)-4-{[3-[2-(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone and can be represented by formula (I):



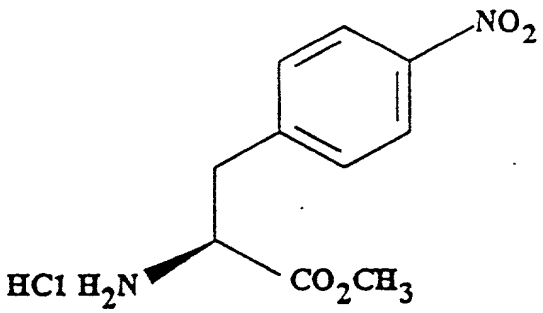
(I)

The compound of formula (I) can exist as its (S) or (R) enantiomer and is specifically exemplified in WO91/18897. A number of possible routes for preparing the compound of formula (I) are suggested in WO91/18897.

A new process for preparing the compound of formula (I) has now been discovered. This process is advantageous over the processes disclosed in WO91/18897 in that it allows the final product to be made at a high yield on a large scale and in pure form by using a one pot procedure, thus avoiding the need for time-consuming and costly isolation of intermediates. The new process also avoids the need for dangerous reagents such as phosgene or environmentally hazardous reagents such as tin chloride.

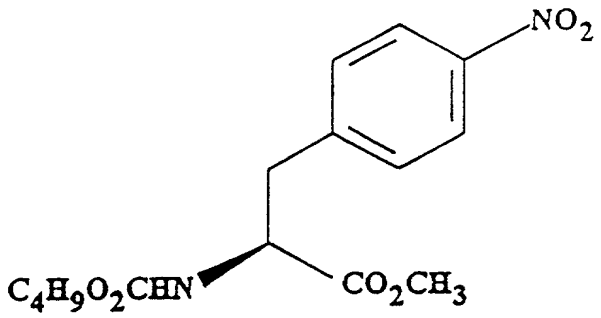
According to the first aspect of the present invention, therefore, there is provided a process for the preparation of a (S)-4-{[3-[2(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone which process comprises the steps of

a) forming a carbamate from methyl 4-nitro-(L)-phenylalaninate hydrochloride, represented by formula (II)



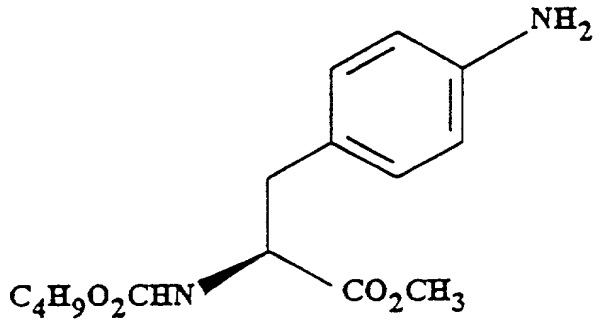
(II)

by adding sodium carbonate or sodium hydrogen carbonate and n-butyl chloroformate and reacting to give methyl(S)-N-butoxycarbonyl-4-nitrophenylalaninate, represented by formula (III)



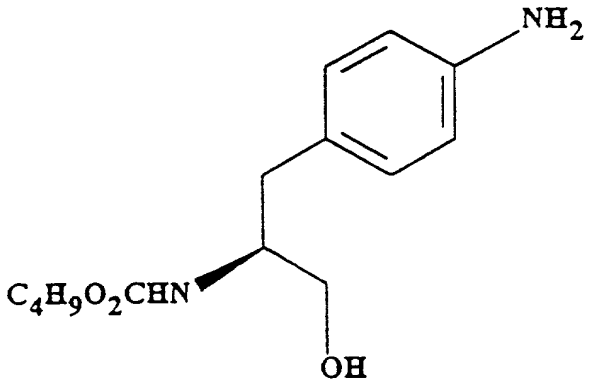
(III)

b) reducing the compound of formula (III) to give methyl (S)-N-butoxycarbonyl-4-amino phenylalaninate, represented by formula (IV)



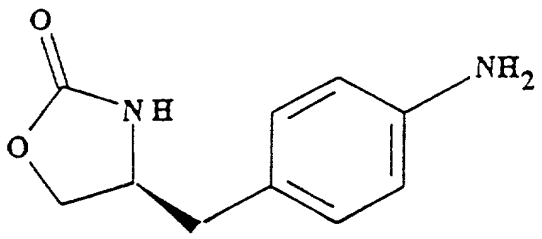
(IV)

c) reducing the methyl ester grouping $-CO_2CH_3$ in the compound of formula (IV) to give (S)-N-butoxycarbonyl-4-aminophenylalaninol, represented by formula (V)



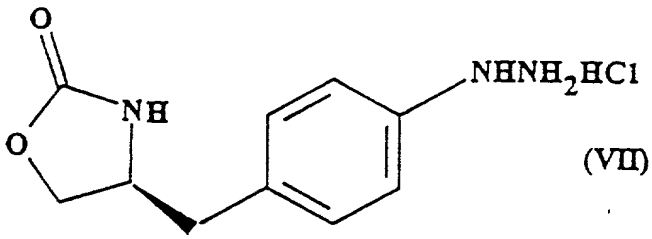
(V)

d) a ring closure of the compound of formula (V) to give (S)-4-(4-aminobenzyl)-2-oxazolidinone, represented by formula (VI)



(VI)

e) preparation of the diazonium salt of the compound of formula (VI) followed by reduction to give the hydrazine (S)-4-(4-hydrazinobenzyl)-2-oxazolidinone hydrochloride, represented by formula (VII)



(VII)

f) Fischer reaction of the compound of formula (VII) to give the compound of formula (I)

Suitably, one or more of steps a) to f) are carried out using a one pot procedure. Preferably steps a) to d) are carried out by a one pot procedure followed by isolation of the compound of formula (VI) and then a second one pot procedure for steps e) and f).

Step a) is conveniently carried out in the presence of a solvent e.g. aqueous ethyl acetate or dioxane. Aqueous ethyl acetate is preferred. Sodium carbonate is used in preference to sodium hydrogen carbonate and is preferably added prior to the n-butyl chloroformate. The reaction is conveniently carried out at a non-extreme temperature, suitably in the range 5-60°C. Preferably the reaction is carried out at 15-35°C. In a particularly preferred embodiment the addition of sodium carbonate takes place at a temperature of approximately 20°C and the addition of N-butyl chloroformate takes place at a temperature of approximately 30°C.

The reduction step b) is conveniently carried out in the presence of an organic solvent, e.g. ethyl acetate or ethanol. Preferably step b) is carried out by a one pot procedure using the ethyl acetate solution of the compound of formula (III) which results from step

a). Suitably, step b) is carried out by hydrogenation, preferably in the presence of a catalyst such as palladium charcoal. The reaction may be carried out under an atmosphere of nitrogen using hydrogen at normal atmospheric pressure at room temperature. Hydrogenation is preferably carried out at approximately 20psi of hydrogen at an elevated temperature e.g. 30°C to 50°C. The resulting ethyl acetate solution of the compound of formula (IV) is preferably converted into a butanol solution which can be used directly, as part of a one pot procedure, in step c). This conversion can conveniently be carried out by partial distillation of the ethyl acetate solution followed by addition of butanol and fractionation to remove the ethyl acetate.

The methyl ester reduction of step c) is conveniently carried out in the presence of a solvent e.g. SVM or n-butanol. Preferably step c) is carried out as part of a one pot procedure by preparing a n-butanol solution from the ethyl-acetate solution of the compound of formula (IV) and then directly reducing the n-butanol solution. The reduction is preferably effected using sodium borohydride and is conveniently carried out at a non-extreme temperature suitably 20-40°C. Preferably, the reduction is carried out in two phases; the first phase being carried out under nitrogen at a temperature of approximately 25°C; and the second phase being carried out at approximately 30°C. The resulting n-butanol solution of the compound of formula (V) can then be dried using hydrochloric acid and ammonia. The dry n-butanol solution can be used directly in step d) as part of a one pot procedure.

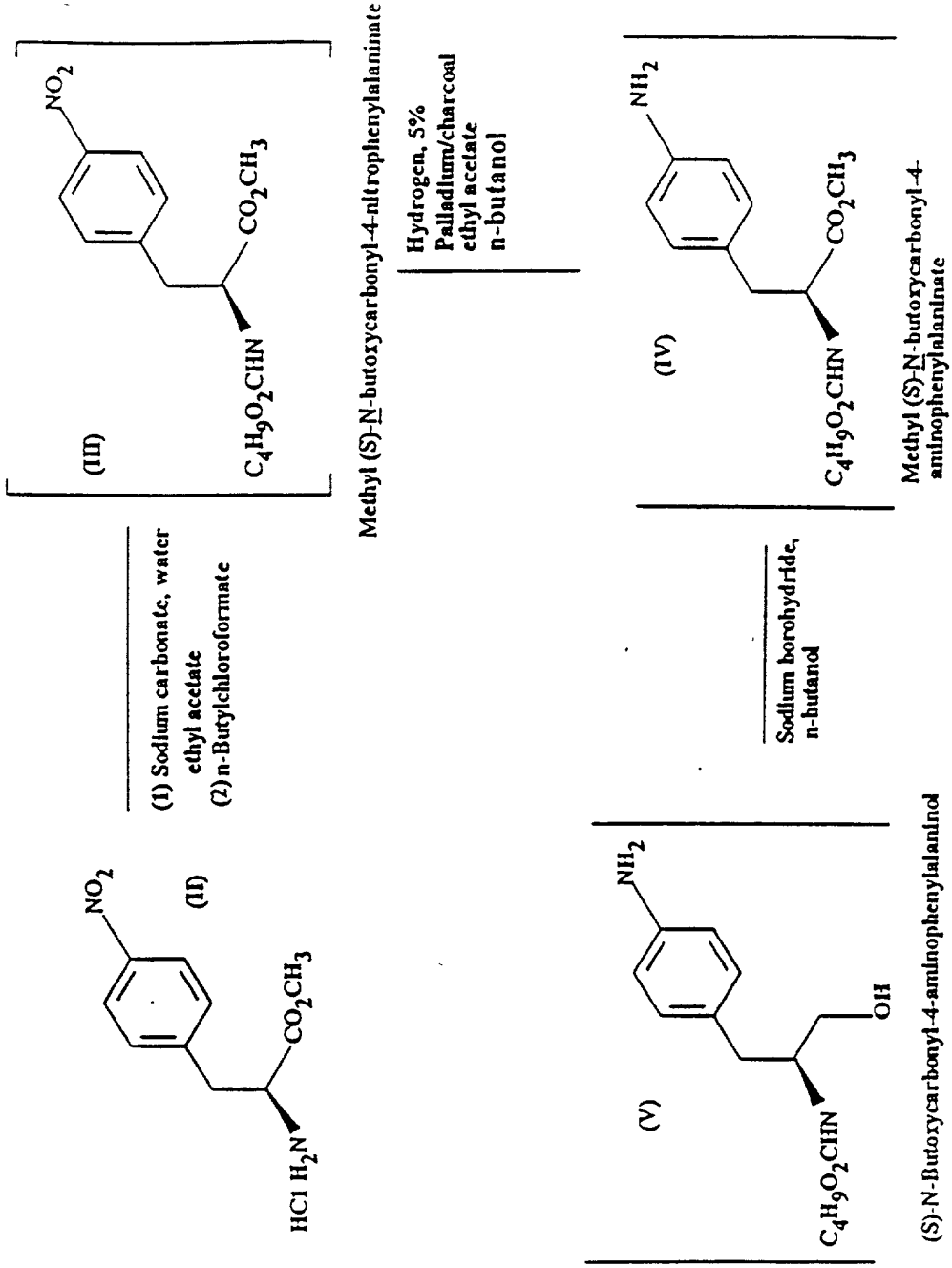
Step d) is preferably carried out on a dry solution, e.g. a dry butanol solution, of the compound of formula (V). Such a dry butanol solution is advantageously prepared by drying the n-butanol solution which is produced by step c). The dry n-butanol solution is preferably decolourised using charcoal before carrying out the ring closure reaction. The ring closure can be conveniently effected using sodium methoxide, suitably in an alcoholic solvent e.g. methanol. Most preferably, the ring closure is carried out using a 30% solution of sodium methoxide in methanol. The reaction is preferably carried out at an elevated temperature which is suitably in the range 50-120°C. Preferably the reaction is carried out at approximately 85°C. The resulting compound of formula (VI) may then be isolated. This isolation can be carried out by standard centrifugation, filtration and drying methods.

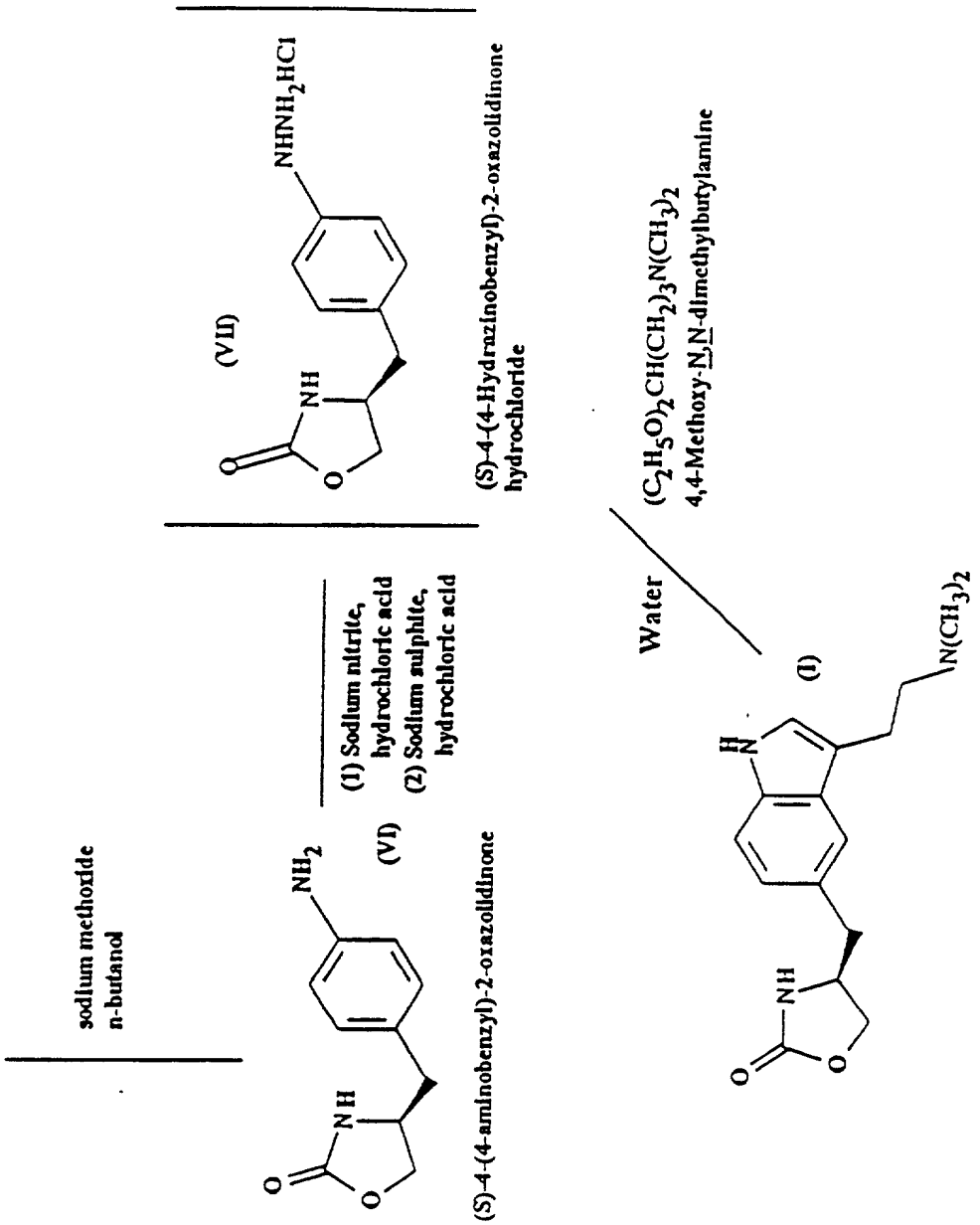
Step e) is preferably carried out on the isolated compound of formula (VI). Isolation can be achieved, for example, using well known centrifugation, filtration and drying techniques. Diazonium salt formation can be carried out using aqueous sodium nitrite solution, preferably in the presence of concentrated hydrochloric acid, at a reduced temperature. Preferably the salt formation is carried out at a reduced temperature, e.g. 0-5°C. Hydrazine formation is then carried out on the diazonium salt solution by using sodium sulphite as a reducing agent. The sodium sulphite is suitably in the form of an aqueous solution. The reduction is advantageously carried out in two phases: the first being addition of sodium sulphite; the second being addition of hydrochloric acid. Preferably the first phase is carried out at a temperature below 10°C. The second phase is preferably carried out at an elevated temperature e.g. 55-60°C.

The solution of the compound of formula (VII) which results from step e) is preferably used directly in step f) as a one pot procedure. Step f) is a Fischer reaction. It has been found to be advantageous to carry out this reaction at a relatively high dilution in order to maximise the purity of the final product. Accordingly the solution which results from step e) is preferably diluted with water. The Fischer reaction is then carried out by adding 4,4-diethoxy-N,N-dimethylbutylamine, suitably under a nitrogen atmosphere. Preferably, when the 4,4-diethoxy-N,N-dimethylbutylamine is added, the diluted solution is at an elevated temperature. A suitable temperature is in the range 75-105°C, and is preferably approximately 90°C. The reaction preferably proceeds under reflux.

When the reaction is complete, the compound of formula (I) can be extracted using standard techniques. Suitably the refluxed reaction product is cooled and adjusted to about pH7, e.g. using sodium hydroxide. The pH adjusted product can then be extracted with ethyl acetate and the aqueous layer adjusted to about pH 10 with sodium hydroxide. The product can then be extracted at approximately 50°C, followed by standard decolourising, filtration, distillation, centrifugation and drying techniques.

A particularly preferred reaction scheme for the preparation of the compound of formula (I) is


(II)
HCl H2N
CO2CH3
NO2
(1) Sodium carbonate, water
ethyl acetate
(2) n-Butylchloroformate
(III)
C4H9O2CHN
CO2CH3
NO2
Methyl (S)-N-butoxycarbonyl-4-nitrophenylalaninate
Hydrogen, 5%
Palladium/charcoal
ethyl acetate
n-butanol
(IV)
C4H9O2CHN
CO2CH3
NH2
Methyl (S)-N-butoxycarbonyl-4-aminophenylalaninate
Sodium borohydride,
n-butanol
(V)
C4H9O2CHN
OH
NH2
(S)-N-Butoxycarbonyl-4-aminophenylalaninol


sodium methoxide
n-butanol
(S)-4-(4-aminobenzyl)-2-oxazolidinone
(VI)
(1) Sodium nitrite, hydrochloric acid
(2) Sodium sulphite, hydrochloric acid
(VII)
(S)-4-(4-Hydrazinobenzyl)-2-oxazolidinone hydrochloride
Water
(I)
4,4-Methoxy-N,N-dimethylbutylamine

According to the second aspect of the present invention, there is provided a process for the purification of (S)-4-{[3-(dimethylamino)ethyl]-1H-indol-5-yl]-methyl}-2-oxazolidinone which process comprises the steps of

a) dissolving crude (S)-4-{[3-(dimethylamino)ethyl]-1H-indol-5-yl]-methyl}-2-oxazolidinone in a refluxing mixture of ethanol in ethyl acetate and filtering the hot solution;

b) slowly cooling the filtered solution to a temperature about 5°C

c) centrifuging the product from step b), washing with ethyl acetate then drying; and

d) treating with acetone to remove solvated ethyl acetate.

Preferably the refluxing mixture is 10% ethanol in ethyl acetate. The hot solution is suitably decolourised using decolourising charcoal prior to filtration using filter aid.

The cooled filtered solution of step b) is suitably stirred over a prolonged period, which is preferably approximately 18 hours, prior to centrifugation.

The drying stage of step c) is preferably carried out under vacuum. Suitably the product is dried at an elevated non-extreme temperature, for example 40-60°C, which is preferably approximately 50°C.

The dried solid product of step c) is conveniently treated with a mixture of 20% acetone in water, at a non-extreme temperature, preferably 15-30°C, for example at room temperature. The resulting suspension is then cooled to a non-extreme reduced temperature, preferably about 5°C, and stirred. The product is then centrifuged, washed with ethyl acetate and dried, preferably under vacuum at a temperature of approximately 45°C.

The resulting product is a non-solvated solid of high purity.

In a third aspect, the present invention provides non-solvated, pure (S)-4-{[3-(dimethylamino ethyl)-1H-indol-5-yl]-methyl}-2-oxazolidinone.

In further aspects, the invention provides compounds of formulae (III), (IV), (V) and (VI) as defined hereinbefore.

In still further aspects, the invention provides processes for preparing compounds of formulae (III), (IV), (V) and (VI) as follows:

Compound (III): process step a) of the first aspect of the invention and preferably as described on page 4;

Compound (IV): process step b) of the first aspect of the invention and preferably as described in the paragraph bridging pages 4 and 5;

Compound (V): process step c) of the first aspect of the invention and preferably as described on page 5; and

Compound (VI): process step d) of the first aspect of the invention and preferably as described on page 5.

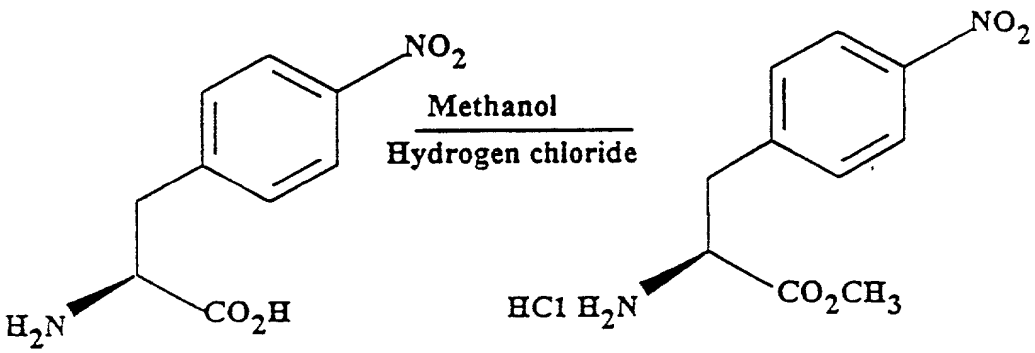
The invention will now be further described by the following examples.

Example 1

A process for preparing (S)-4-[2-(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone in bulk.

STAGE 1: The preparation of methyl 4-nitro-(L)-phenylaninate hydrochloride

REACTION



$C_9H_{10}N_2O_4$
M.W. 210.18

$C_{10}H_{13}N_2O_4Cl$
M.W. 260.67

MATERIALS	QUANTITY	MOLES
4-Nitro-(L)-phenylanine	100.0kg	475.8
Methanol	599.0 litres	
Hydrogen chloride	45.3kg	1241.6
Methanol (wash	66.8 litres	

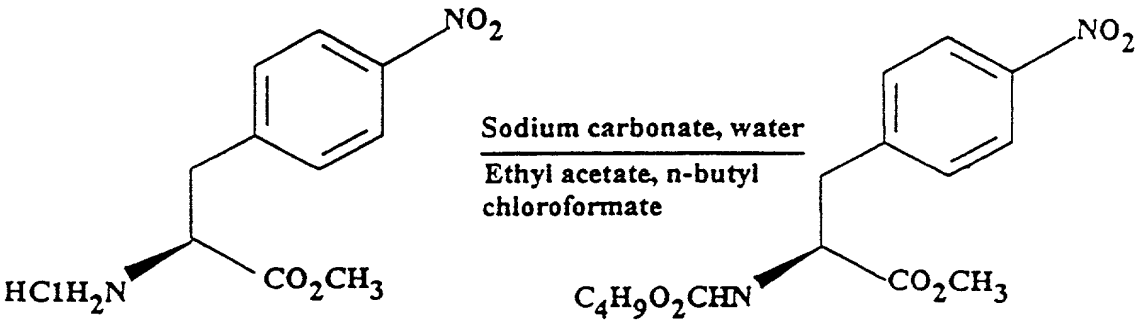
PROCEDURE

Prepare a methanolic solution of hydrogen chloride by passing hydrogen chloride gas into a reactor containing methanol, maintaining temperature below 25°C. Charge to the reactor the 4-nitro-(L)-phenylanine and reflux for about 1 hour. Cool to about 0°C and

centrifuge the product (methyl 4-nitro-(L)-phenylalaninate hydrochloride). Wash the product with methanol and dry *in vacuo* at 50°C.

STAGE 2: The preparation of methyl (S)-N-butoxycarbonyl-4-nitrophenylalaninate

REACTION



$C_{10}H_{13}N_2O_4Cl$
M.W. 260.67

$C_{15}H_{20}N_2O_6$
M.W. 324.33

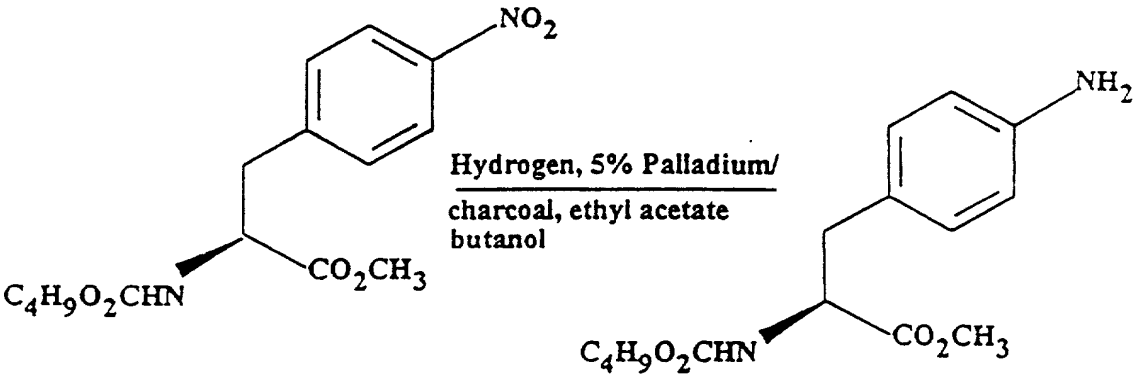
MATERIALS	QUANTITY	MOLES
Methyl 4-nitro-(L)-phenylalaninate hydrochloride	45.0kg	172.7
Sodium carbonate	20.1kg	189.6
n-Butyl chloroformate	24.0kg	175.8
Ethyl acetate	248.0kg	
Water (demineralised)	100.0kg	
Water (wash)	50.0kg	

PROCEDURE

Charge to the reactor demineralised water, methyl 4-nitro-(L)-phenylalaninate hydrochloride, sodium carbonate and ethyl acetate and cool the contents to about 20°C with stirring. Add the n-butyl chloroformate to the reaction mixture whilst maintaining the temperature at about 30°C and stir for about 30 minutes. Separate the aqueous layer and wash the ethyl acetate solution with water. The ethyl acetate solution of methyl (S)-N-butoxycarbonyl-4-nitrophenylalaninate is used directly at the next stage.

STAGE 3: The preparation of methyl (S)-N-butoxycarbonyl-4-aminophenylaninate

REACTION



$C_{15}H_{20}N_2O_6$
M.W. 324.33

$C_{15}H_{22}N_2O_4$
M.W. 294.33

MATERIALS	QUANTITY	MOLES
Methyl (S)-N-butoxycarbonyl-4-nitrophenylalaninate	56.0kg	172.7
Ethyl acetate	252.0kg	
5% Palladium charcoal (55% water wet)	5.0kg	
Ethyl acetate (filter wash)	18.0kg	
Sodium carbonate	12.5kg	
Water (demineralised)	100.0kg	
Filter aid	3.5kg	
Hydrogen	as required	
Butanol	247.1kg	

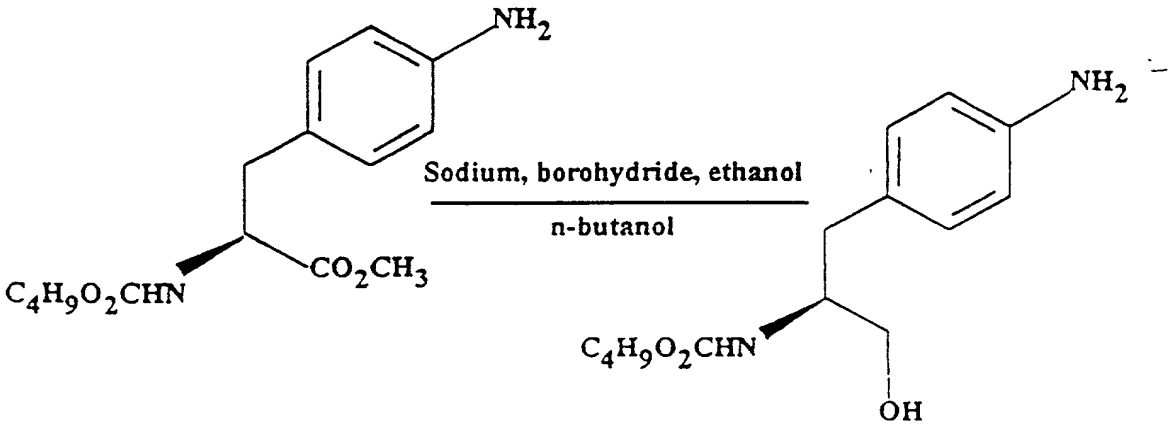
PROCEDURE

Charge to the reactor the 5% palladium charcoal catalyst, the ethyl acetate solution of methyl (S)-N-butoxycarbonyl-4-nitrophenylalaninate and hydrogenate at about 20 psi of

hydrogen, maintaining a temperature between 30°C and 50°C. On completion, filter off the catalyst through filter aid and wash with ethyl acetate. Wash the ethyl acetate solution with aqueous sodium carbonate solution. The ethyl acetate solution of methyl (S)-N-butoxycarbonyl-4-aminophenylalaninate is partially distilled, butanol added and the mixture fractionated to remove the ethyl acetate. The butanol solution is used directly at the next stage.

STAGE 4: The preparation of (S)-N-butoxycarbonyl-4-aminophenylalaninol.

REACTION



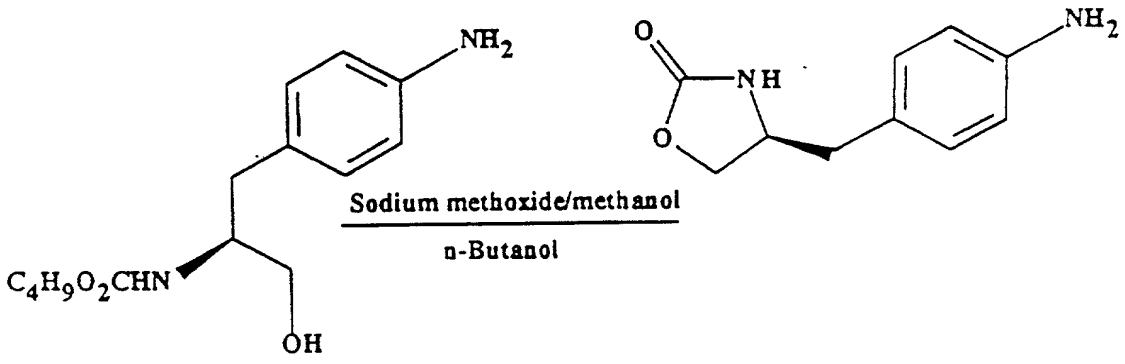
$C_{15}H_{22}N_2O_4$	$C_{14}H_{22}N_2O_3$	
M.W. 294.33	M.W. 266.34	
MATERIALS	QUANTITY	MOLES
Methyl (S)-N-butoxycarbonyl-4-aminophenylaminate	50.8kg	172.8
n-Butanol	305 litres	
Sodium borohydride (total)	6.5kg	172.8
conc. Hydrochloric acid	20.2 litres	300
Water (demineralised - for dilution of acid)	20.2kg	
Water (demineralised)	150.0kg	
conc. Ammonia solution (d=0.88)	14.6 litres	

PROCEDURE

Charge to the reactor the butanol solution of methyl (S)-N-butoxycarbonyl-4-aminophenylalaninate from Stage 3, and dilute with n-butanol to the required volume. Cool the reactor contents to about 25°C. Under a nitrogen atmosphere add half the amount of sodium borohydride whilst maintaining a reaction temperature of about 25°C. Stir for 3 hours and then add the second half of sodium borohydride. Further stir the mixture for 5 hours and warm to 35°C. After this time stir the reaction mixture for about 12 hours and then slowly add aqueous hydrochloric acid, maintaining temperature at about 30°C, to decompose any excess sodium borohydride. Add water, warm to about 35°C and add ammonia solution to adjust to approximately pH10. Separate the aqueous layer and whilst maintaining a temperature of about 35°C, wash the organic layer with water. Distil some of the butanol, whilst simultaneously azeotroping dry the solution. The dry butanol solution is used directly at the next stage.

STAGE 5: The preparation of (S)-4-(4-aminobenzyl)-2-oxazolidinone.

REACTION



$C_{14}H_{22}N_2O_3$
M.W. 266.34

$C_{10}H_{12}N_2O_2$
M.W. 192.21

MATERIALS QUANTITY MOLES

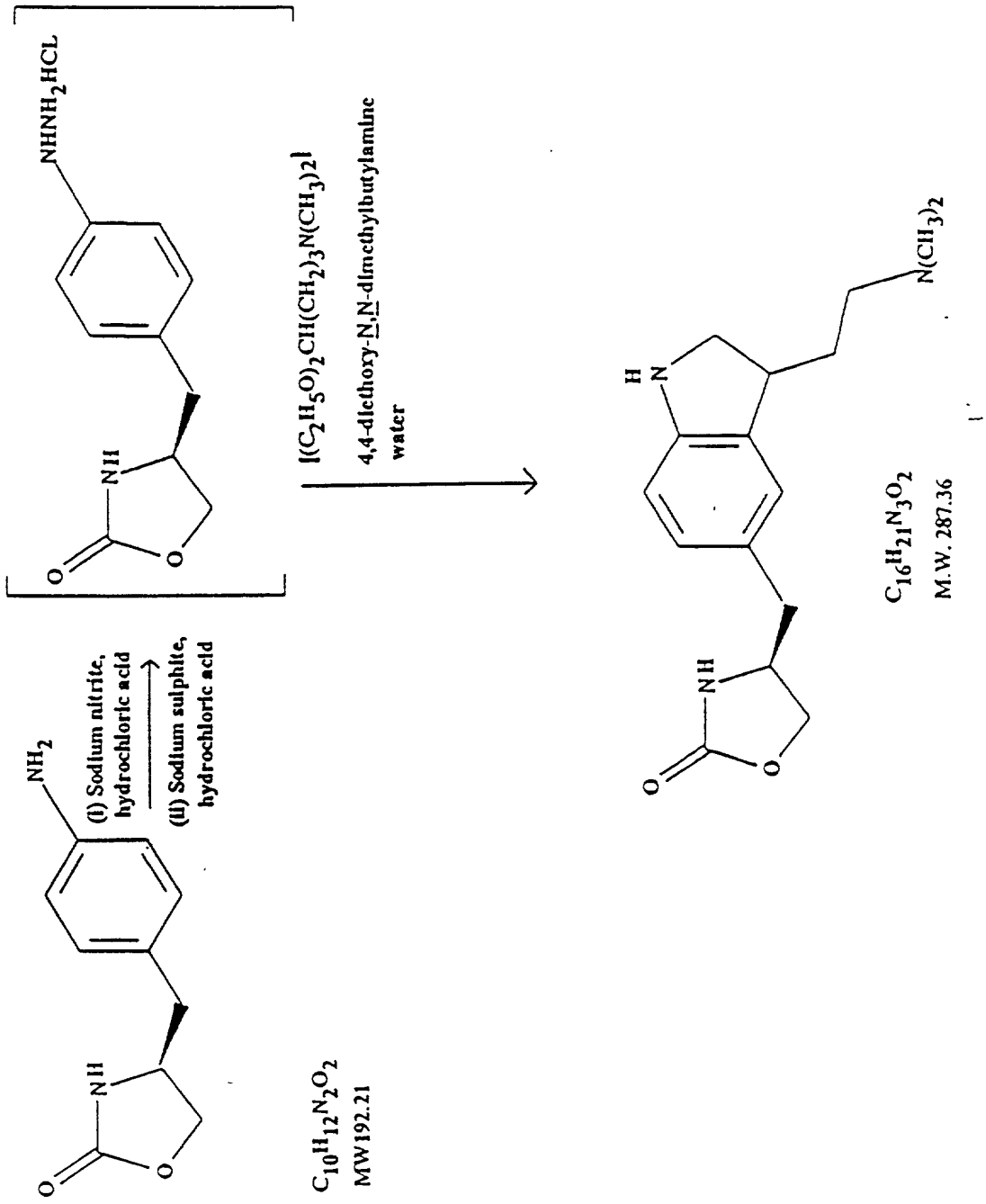
(S)-N-Butoxycarbonyl-4-aminophenylalaninol	91.9kg	345.0
n-Butanol	260.0 litres	
Sodium methoxide (30% weight in methanol solution)	7.5kg	4.7
Charcoal	2.0kg	
n-Butanol (filter wash)	20.0kg	
n-Butanol (product wash)	30.0kg	
Filter aid	2.0kg	

PROCEDURE

Charge to the reactor the dry solution of (S)-N-butoxycarbonyl-4-aminophenylalaninol in n-butanol from Stage 4 and add decolourising charcoal. Treat the dry solution at about 85°C with the slow addition of sodium methoxide in methanol. Heat the reaction mixture at 85°C with the slow addition of sodium methoxide in methanol. Heat the reaction mixture at 85°C for a further 30 minutes and then filter hot through filter aid. After cooling the solution at 5-10°C for at least 8 hours, centrifuge the mixture, wash the filtered product with n-butanol and dry at about 50°C *in vacuo*.

STAGE 6A: The preparation of (S)-4-{3-[2-(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone.

REACTION


NHNH2HCL
NH
O
O
(I) Sodium nitrite, hydrochloric acid
(II) Sodium sulphite, hydrochloric acid
NH2
NH
O
O
C10H12N2O2
MW192.21
[(C2H5O)2CH(CH2)3N(CH3)2]
4,4-diethoxy-N,N-dimethylbutylamine
water
H
N
N(CH3)2
NH
O
O
C16H21N3O2
M.W. 287.36

MATERIALS	QUANTITY	MOLES
(S)-4-(4-Aminobenzyl)-2-oxazolidinone	19.2kg	100.0
Sodium nitrite	6.9kg	100.0
Sodium sulphite	37.8kg	300.0
conc. Hydrochloric acid	66.6kg	
4,4-Diethoxy-N,N-dimethylbutylamine	19.0kg	100.0
32% w/w Sodium hydroxide solution	60.0kg	
Ethyl acetate (total extracts)	303.0 litres	
Charcoal	2.9kg	
Water (demineralised)	412.8kg	
Ethyl acetate (wash)	10.0 litres	
Filter aid (total used)	2.0kg	

PROCEDURE

Charge to the reactor conc. hydrochloric acid, demineralised water and (S)-4-(4-aminobenzyl)-2-oxazolidinone. Cool the reactor contents to between 0-5°C and add aqueous sodium nitrite solution, maintaining the temperature below 5°C. After stirring for about 30 minutes add the diazonium salt solution to a chilled aqueous solution of sodium sulphite, maintaining the temperature below 10°C. After stirring for 15 minutes slowly heat the resulting mixture to about 55-60°C, and then slowly add hydrochloric acid. The solution is maintained at about 60°C for about 18 hours.

Dilute the reaction mixture with water and heat to about 90°C. Under a nitrogen atmosphere slowly add 4,4-diethoxy-N,N-dimethylbutylamine and heat at reflux for about 3 hours. Cool, and adjust the mixture to about pH7 using sodium hydroxide solution. Extract with ethyl acetate and then adjust the aqueous layer to about pH10, again using sodium hydroxide solution. Extract the product at about 50°C using ethyl acetate. Treat the combined ethyl acetate extracts (containing the product) with decolourising charcoal, and filter through filter aid. Distil off most of the solvent and chill the suspension to about 5°C. Centrifuge the crude product, wash with ethyl acetate and vacuum dry at 50°C.

STAGE 6B : Purification of (S)-4-{3-[2-(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone

MATERIALS	QUANTITY
Ethyl acetate	109.4 litres
Ethanol	12.3 litres
Charcoal	2.4 kg
Ethyl acetate (product wash)	5.0 litres
Acetone	11.8 litres
Water (demineralised)	47.3 kg
Water (demineralised) (product wash)	10.0 kg
Filter acid	2.0 kg

The crude product of step 6A is dissolved in a refluxing mixture of 10% ethanol in ethyl acetate, treated with decolourising charcoal and filtered hot through filter aid. The

solution is slowly cooled to above 5°C and stirred for 18 hours. The purified product is then centrifuged, washed with ethyl acetate and vacuum dried at 50°C. In order to remove solvated ethyl acetate, the dry solid is added to a mixture of 20% acetone in water at ambient temperature and stirred for 1 hour. The suspension is cooled to about 5°C for about 1 hour before centrifuging the product, washing with ethyl acetate and drying *in vacuo* at about 45°C.

Example 2

Alternative preparation of Methyl (S)-N-butoxycarbonyl-4-nitrophenylalaninate (Compound of formula (III))

A mixture of methyl-4-nitro-(L)-phenylalaninate hydrochloride (40.00g, 0.153 mole) and sodium hydrogen carbonate (73g, 0.870 mole) in 1,4-dioxane (1000ml) was stirred at approximately 10°C under anhydrous conditions. A solution of butyl chloroformate (23.12g, 21.52ml, 0.169 mole) in 1,4-dioxane (200ml) was added over a period of ten minutes (reaction temperature approximately 13°C). The resulting suspension was allowed to warm to room temperature and stirred for three hours. The reaction was quenched slowly into water (1600ml) and then extracted with ethyl acetate (3 x 650ml). The combined ethyl acetate extracts were washed with brine (1000ml), dried over anhydrous magnesium sulphate, filtered and evaporated to an oil. Residual solvent was removed using an oil pump at 50°C to afford a syrup (51.34g, 103% yield) which gradually solidified on standing.

TLC[SiO_2,EtOAc] was homogeneous (R_f = 0.59).

^{1}H NMR (60 MHz, $CDCl_3$) was consistent with structure of carbamate.

Example 3

Alternative preparation of Methyl (S)-N-butoxycarbonyl-4-aminophenylalaninate (Compound of formula (IV))

A solution of the compound prepared by Example 2 [45.00g, 0.139 mole] in ethanol (845ml) was added to moist 10% palladium on carbon (Type 87L, 61.1% H_2O) [~4.5g]

under an atmosphere of nitrogen. The reaction was set up for hydrogenation at room temperature under normal atmospheric pressure. There was a steady uptake of hydrogen (~9700ml) over nine hours. The catalyst was filtered off on hyflo and washed with ethanol (100ml). The filtrate was concentrated *in vacuo* (water bath temp. <40°C) and the last traces of solvent removed using an oil pump to afford a brown gum (41.70g, 101%).

TLC [SiO_2, EtOAc] showed the required product (R_f = 0.49) with traces of a faster running impurity.

^{1}H NMR (300 MHz, $CDCl_3$) was consistent with structure of product and residual ethanol.

Example 4

Alternative preparation of (S)-N-Butoxycarbonyl-4-aminophenylalaninol (Compound of formula (V)).

To a stirred suspension of sodium borohydride (14.80g, 0.390 mole) in SVM (150ml), was added dropwise a solution of the compound prepared by Example 3 [76.40g, 0.260 mole) in SVM (460ml) at room temperature. The reaction was left stirring overnight (~18 hours) after which TLC (SiO_2, EtOAc) indicated complete consumption of starting material. The reaction mixture was acidified to ~pH4 with 2M aqueous hydrochloric acid with ice-cooling to a temperature of approximately 10°C. The resulting mixture was concentrated to a solid residue and saturated aqueous sodium hydrogen carbonate (2000ml) was added slowly. The aqueous mixture (pH~8) was extracted with ethyl acetate (2 x 750ml) and the combined organic extracts dried (magnesium sulphate), filtered and concentrated to a pale pink waxy sold (64.56g, 93% yield).

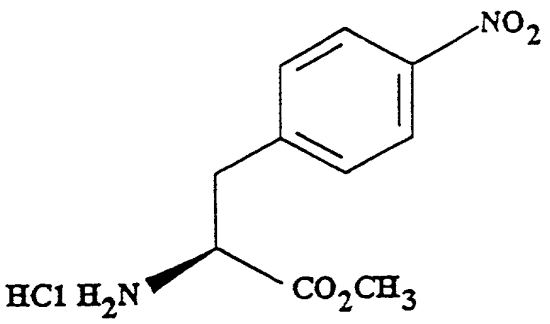
TLC [SiO_2, EtOAc] indicated the required product (R_f = 0.33) with traces of impurities.

^{1}H NMR (60 MHz, $CDCl_3$) was consistent with structure of alaninol.

CLAIMS

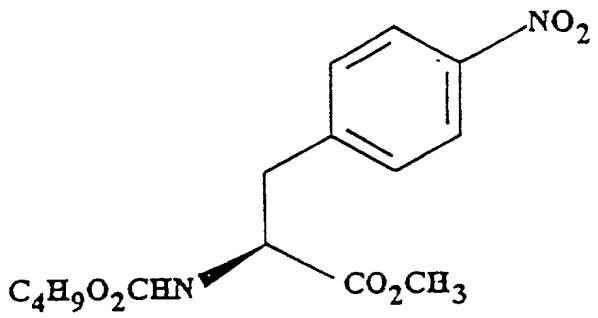
1. A process for the preparation of a (S)-4-{[3-[2(dimethylamino)ethyl]-1H-indol-5-yl]methyl}-2-oxazolidinone which process comprises the steps of

a) forming a carbamate from methyl 4-nitro-(L)-phenylalaninate hydrochloride, represented by formula (II)



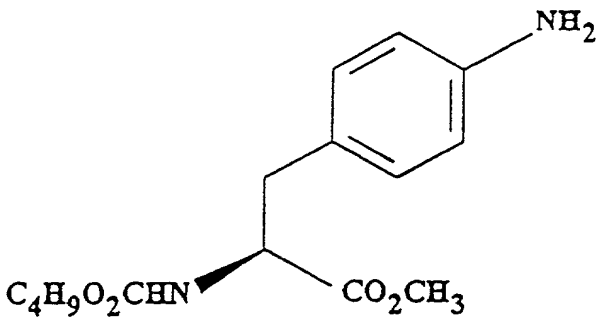
(II)

by adding sodium carbonate or sodium hydrogen carbonate and n-butyl chloroformate and reacting to give methyl(S)-N-butoxycarbonyl-4-nitrophenylalaninate, represented by formula (III)



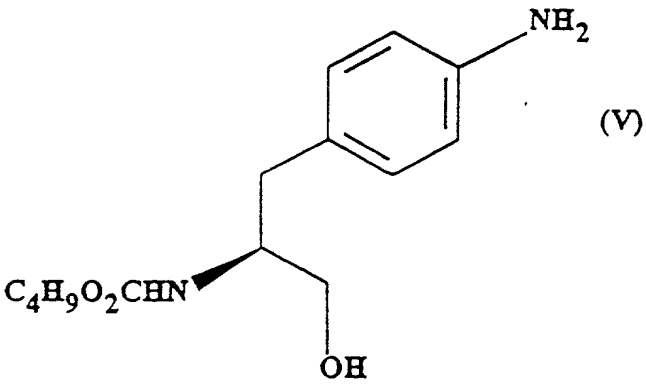
(III)

b) reducing the compound of formula (III) to give methyl (S)-N-butoxycarbonyl-4-amino phenylalaninate, represented by formula (IV)



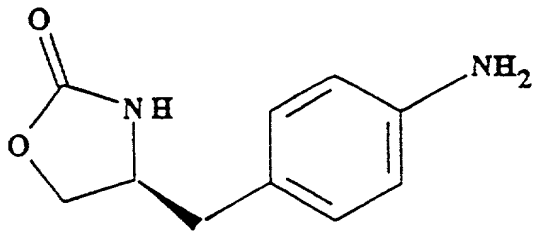
(IV)

c) reducing the methyl ester grouping $-CO_2CH_3$ in the compound of formula (IV) to give (S)-N-butoxycarbonyl-4-aminophenylalaninol, represented by formula (V)



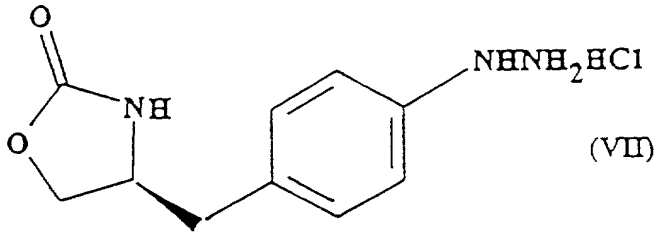
(V)

d) a ring closure of the compound of formula (V) to give (S)-4-(4-aminobenzyl)-2-oxazolidinone, represented by formula (VI)



(VI)

e) preparation of the diazonium salt of the compound of formula (VI) followed by reduction to give the hydrazine (S)-4-(4-hydrazinobenzyl)-2-oxazolidinone hydrochloride, represented by formula (VII)



(VII)

f) Fischer reaction of the compound of formula (VII) to give the compound of formula (I)

2. A process according to Claim 1 wherein one or more of steps (a) to (f) are carried out using a one pot procedure.

3. A process according to Claim 1 or 2 wherein steps a) to d) are carried out by a one pot procedure followed by isolation of the compound of formula (VI) and then a second one pot procedure for steps e) and f).

4. A process according to any one of Claims 1 to 3 wherein step a) is carried out in the presence of an aqueous ethyl acetate solvent, using sodium carbonate.

5. A process according to Claim 4 wherein the addition of sodium carbonate in step (a) takes place at a temperature of approximately 20°C and the addition of N-butyl chloroformate takes place at a temperature of approximately 30°C.

6. A process according to any one of Claims 1 to 5 wherein step b) is carried out by hydrogenation.

7. A process according to any one of Claims 1 to 6 wherein the step (c) reduction is effected using sodium borohydride.

8. A process according to any one of Claims 1 to 7 wherein step d) is carried out on a dry butanol solution of the compound of formula (V).

9. A process according to any one of Claims 1 to 8 wherein the ring closure is carried out using a 30% solution of sodium methoxide in methanol at a temperature which is in the range 50-120°C.

10. A process according to any one of Claims 1 to 9 wherein step (e) is carried out by

(i) reacting the compound of formula (VI) with sodium nitrite, and

(ii) reducing the diazonium salt formed in (i) using sodium sulphite.

11. A process according to any one of Claims 1 to 10 wherein the Fischer reaction of step (f) is carried out at a relatively high dilution.

12. A process for the purification of (S)-4-{[3-(dimethylamino)ethyl]-1H-indol-5-yl]-methyl}-2-oxazolidinone which process comprises the steps of

a) dissolving crude (S)-4-{[3-)dimethylamino)ethyl]-1H-indol-5-yl]-methyl}-2-oxazolidinone in a refluxing mixture of ethanol in ethyl acetate and filtering the hot solution;

b) slowly cooling the filtered solution to a temperature of about 5°C

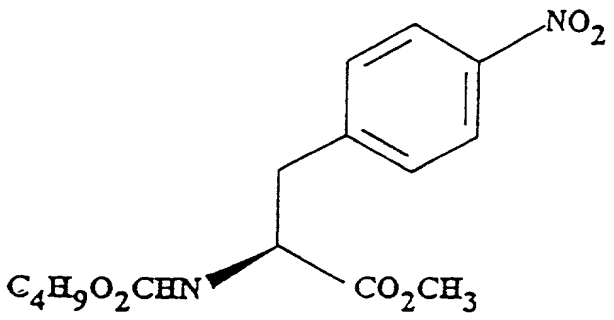
c) centrifuging the product from step b), washing with ethyl

acetate then drying; and

d) treating with acetone to remove solvated ethyl acetate.

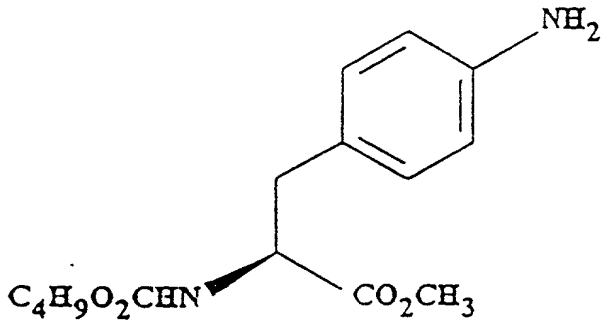
13. Non-solvated, pure (S)-4-{[3-(dimethylamino ethyl)-1H-indol-5-yl]-methyl}-2-oxazolidinone.

14. An intermediate of formula (III)



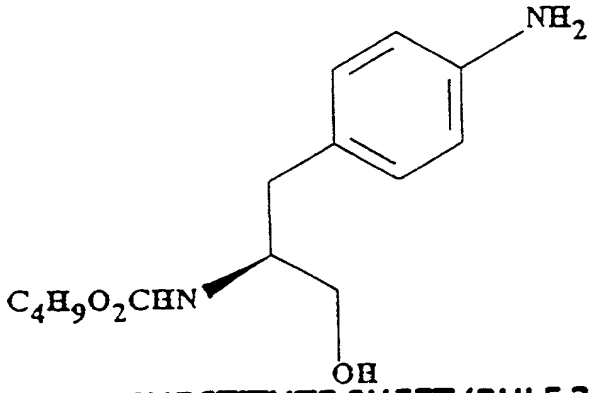
(III)

15. An intermediate of formula (IV)



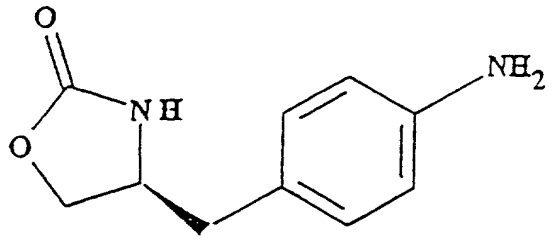
(IV)

16. An intermediate of formula (V)



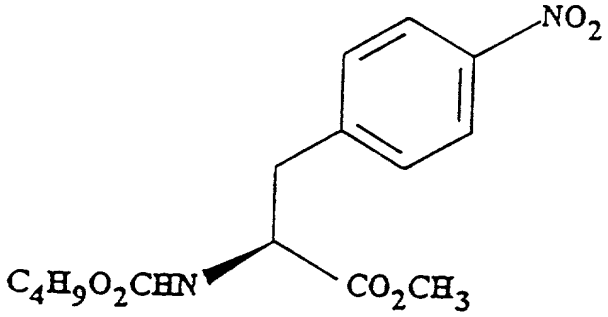
(V)

17. An intermediate of formula (VI)



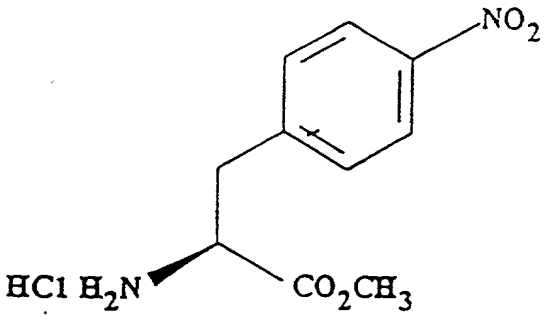
(VI)

18. A process for the preparation of a compound of formula (III)



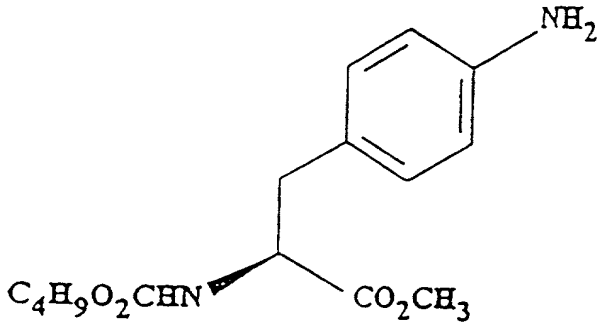
(III)

which process comprises reacting a compound of formula (II) with sodium carbonate and n-butylchloroformate.



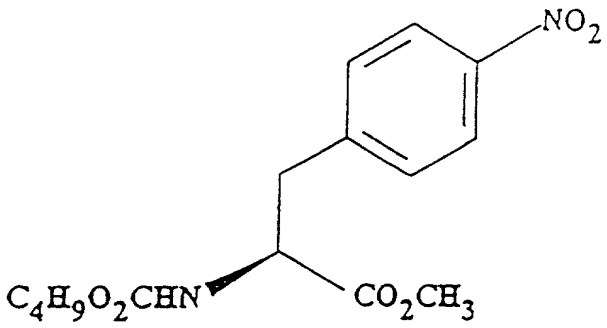
(II)

19. A process for the preparation of a compound of formula (IV)



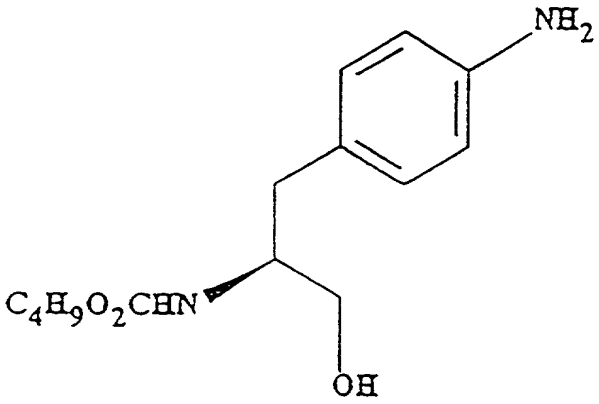
(IV)

which process comprises reducing a compound of formula (III)



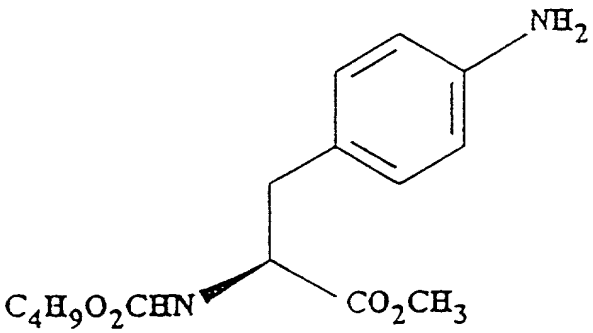
(III)

20. A process for the preparation of a compound of formula (V)



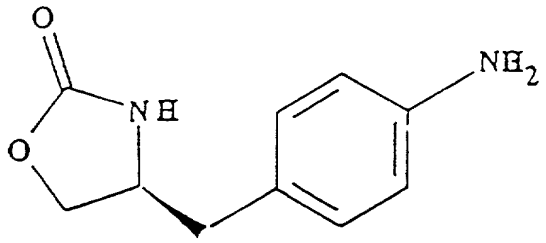
(V)

which process comprises reduction of a compound of formula (IV)



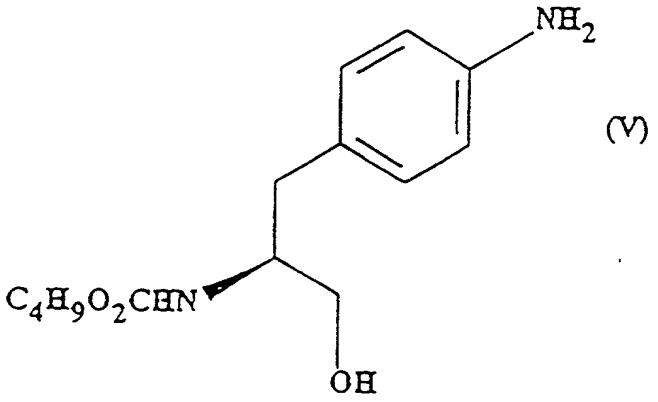
(IV)

21. A process for the preparation of a compound of formula (VI)



(VI)

which process comprises a ring closure of a compound of formula (V)



(V)

22. Use of an intermediate as claimed in Claim 14 in the manufacture of a composition for use in medicine.

23. Use of an intermediate as claimed in Claim 15 in the manufacture of a composition for use in medicine.

24. Use of an intermediate as claimed in Claim 16 in the manufacture of a composition for use in medicine.

25. Use of an intermediate as claimed in Claim 17 in the manufacture of a composition for use in medicine.

26. Use as claimed in any one of Claims 22 to 25 wherein the composition is for use in the treatment and prophylaxis of migraine.

Attorney Docket No _____

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought, on the invention entitled:
ONE POT SYNTHESIS OF 2-OXAZOLIDINONE DERIVATIVES

the specification of which is attached and/or was filed on _____ as United States Application Serial No. or PCT International Application No. PCT/GB96/01885 and was amended on _____(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability in accordance with Title 37, CFR § 1 56.

I hereby claim foreign priority benefits under Title 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT International application(s) designating at least one country other than the United States, listed below and have also identified below, any foreign application(s) for patent or inventor's certificate, or any PCT International application(s) having a filing date before that of the application(s) of which priority is claimed:

Country	Application Number	Date of Filing	Priority Claimed Under 35 U.S.C 119	
United Kingdom	9516145.1	07 AUGUST 1995	X YES	NO
			YES	NO

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

Application Number	Date of Filing

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) or or § 365(c) of any PCT International application(s) designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application(s) in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37CFR § 1.56 which became available between the filing date of the prior application(s) and the national or PCT International filing date of this application:

Application Number	Date of Filing	Status (Patented, Pending, Abandoned)

I hereby appoint the following attorney and/or agent(s) to prosecute this application and transact all business in the Patent andTrademark Office connected therewith. **FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P., Reg. No. 22,540**, Douglas B. Henderson, Reg. No. 20,291; Ford F. Farabow, Jr. Reg. No. 20,630; Arthur S. Garrett, Reg. No. 20,338; Donald R. Dunner, Reg. No. 19,073; Brian G. Brunsvold, Reg. No 22,593; Tipton, D. Jennings IV, Reg. No. 20,645; Jerry D. Voight, Reg. No. 23,020; Laurence R. Hefter, Reg. No. 20,827; Kenneth E. Payne, Reg. No 23,098; Herbert H. Mintz, Reg. No. 26,691; C. Larry O'Rourke, Reg. No. 26,014; Albert J. Santorelli, Reg. No. 22,610; Michael C. Elmer, Reg. No. 25,857; Richard H. Smith, Reg. No. 20,609; Stephen L. Peterson, Reg. No. 26,325; John M. Romary, Reg. No. 26,331; Bruce C. Zotter, Reg. No 27,680; Dennis P. O'Reilly, Reg. No. 27,932; Allen M. Sokal, Reg. No. 26,695; Robert D. Bajefsky, Reg. No. 25,387; Richard L. Stroup, Reg. No 28,478; David W. Hill, Reg. No. 28,220; Thomas L. Irving, Reg. No. 28,619; Charles E. Lipsey, Reg. No. 28,165; Thomas W. Winland, Reg. No. 27,605; Basil J. Lewris, Reg. No. 28,818; Martin I. Fuchs, Reg. No. 28,508; E. Robert Yoches, Reg. No. 30,120; Barry W. Graham, Reg. No. 29,924; Susan Haberman Griffen, Reg. No. 30,907; Richard B. Racine, Reg. No. 30,415; Thomas H. Jenkins, Reg. No. 30,857; Robert E. Converse, Jr., Reg. No. 27,432; Clair X. Mullen, Jr., Reg. No. 20,348; Christopher P. Foley, Reg. No. 31,354; John C. Paul, Reg. No. 30,413; Roger D. Taylor, Reg. No. 28,992; David M. Kelly, Reg. No. 30,953; Kenneth J. Meyers, Reg. No. 25,146; Carol P. Einaudi, Reg. No. 32,220; Walter Y. Boyd, Jr., Reg. No. 31,738; Steven M. Anzalone, Reg. No. 32,095; Jean B. Fordis, Reg. No. 32,984; Barbara C. McCurdy, Reg. No. 32,120; James K. Hammond, Reg. No. 31,964; Richard V. Burgujian, Reg. No. 31,744; J. Michael Jakes, Reg. No. 32,824; Dirk D. Thomas, Reg. No. 32,600; Thomas W. Banks, Reg. No. 32,719; Christopher P. Isaac, Reg. No. 32,616; Bryan C. Diner, Reg. No. 32,409; M. Paul Barker, Reg. No. 32,013; Andrew Chanho Sonu, Reg. No. 33,457; David S. Forman, Reg. No. 33,694; Vincent P. Kovalick, Reg. No. 32,867; and _____. Please address all correspondence to FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P. 1300 I Street, N.W., Washington, D.C.20005, Telephone No. (202) 408-4000.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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